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Foundation restorations for pulpless teeth

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Purpose

The purpose of this clinical update is to assist the clinician in selecting the materials and techniques appropriate for the restoration of endodontically treated teeth that require a full coverage restoration.

Introduction

The endodontically treated tooth requires special restorative consideration because it has shown a proclivity for fracture, and usually has lost a considerable amount of tooth structure due to caries, endodontic therapy, and/or previous restoration (1). When restoring endodontically treated teeth the following factors should be assessed (2):

- Good apical seal
- No sensitivity to pressure
- No exudate
- No fistula
- No apical sensitivity
- No active inflammation

Using a post system to retain a core, over which a crown can be placed, is often necessary when inadequate coronal tooth structure remains. A unique balance exists between maximizing retention of the post and maintaining resistance to root fracture. Resistance to root fracture is directly related to the thickness of remaining dentin, especially in the buccolingual direction (3). The amount of alteration, the location of the tooth, its current morphology and the manner in which it is restored, all will affect the degree to which dentin is susceptible to fracture (4). Six features of successful design when creating a post space are (2):

1. Adequate apical seal. At least 4-5 mm of gutta percha should remain.
2. Adequate post length: a) optimum length is 2/3 to 3/4 of the root length. b) post length at least 1/2 the length of the root contained in bone.
3. Minimal canal enlargement.
4. Positive horizontal stop in order to minimize wedging.
5. Vertical wall to prevent rotation.
6. Extension of the final restoration margin onto sound tooth structure.

Indications for cast post and core

Tooth reduction for an esthetic crown combined with the dentin lost during access preparation usually leaves minimal coronal foundation for retention of an artificial crown; thus the cast post and core is usually the coronoradicular stabilizer of choice for single-rooted teeth and premolars (5). During preparation for a custom-cast post and core, gross undercuts in the pulpal chamber are removed or blocked-out with cement to ensure a path of insertion. Increasing the diameter of the post does not provide a significant increase in the retention of the post, however, it can increase the stiffness of the post at the expense of the remaining dentin and the fracture resistance of the root (3,4). The cast post and core should be passively fitted to the prepared root canal space and designed to resist rotational forces (5).

Techniques of fabricating cast post and cores

A reliable method for fabricating a custom cast post and core is direct fabrication of the pattern utilizing autopolymerizing resin. The tooth is prepared for the crown after the existing restorations, dental caries, and weakened tooth structure are removed; the post space is then prepared. In vivo studies have suggested that clinical success of posts is directly proportional to their lengths; so it its rational to prepare a post channel as long as is consistent with anatomic limitations while maintaining 4 to 5 mm of apical gutta percha seal (1,6). The post space should provide resistance to rotation of the dowel core. If the configuration of the prepared canal is circular in cross section, a keyway should be placed within the canal (1,7). A positive seat for the core at the opening of the post-space is desirable to prevent overseating of the dowel, which may wedge the root and cause vertical fracture (7).

Alternatively, the post space and remaining tooth structure can be impressed with an elastomer and the resultant cast used to fabricate the custom cast post and core. This indirect method conserves chair time by delegating pattern fabrication to a dental laboratory technician. An accurate impression of the prepared post space is a challenge. Impression material must be injected in the post space and distributed by a spiral paste filler to capture the internal morphology of the canal (1,2). A rigid object such as wire, paper clips or plastic sprues is inserted in the canal before the initial set of impression material to strengthen this impression and minimize potential for distortion.

Prefabricated posts

The use of prefabricated posts with a direct core reconstruction is often regarded as the representative method of choice for restoration of the pulpless molars with substantial loss of tooth structure (1,5). There are numerous types of prefabricated post systems available; however, there are six categories of commercial systems available. These are as follows (2,3):

- Tapered, smooth posts, such as Endo-Post (Kerr), Filpost (Vivadent)
- Parallel-sided, serrated, and vented posts, such as Para post (Whaledent), Triax (Whaledent).
- Tapered, threaded posts, such as Dentatus classic post (Weissman), Ventra-post (Ellman).
- Parallel-sided, threaded, split-shank post such as Flexipost (Essential Dental Systems).
- Parallel-sided threaded post such us Radix Anchor (L. D. Caulk)

- Non-metal posts: Carbon fiber posts such as C Post Dowels (Bisco Dental Products); fiber-reinforced, FibreKor (Jeneric-Pentron); or ceramic posts, Cerapost (Brassler).

Non-metal posts

In response to the need for a post that possesses optical properties compatible with an all-ceramic crown, an all-ceramic post has been developed. This post is composed of zirconium oxide. The zirconia post has been reported to possess high flexural strength and fracture toughness (8). This radiopaque material is biocompatible with some physical properties similar to steel (8). The zirconia post and tooth colored, fiber reinforced posts were designed for use with adhesive resin cement. These posts were intended for use with composite core materials; however, a large composite core may not be rigid enough to support a brittle all-ceramic crown and may suffer premature failure due to water absorption or microleakage secondary to differential coefficients of thermal expansion (1,2).

The ferrule effect

A post and core in a pulpless tooth can transfer occlusal forces intraradicularly with resultant predisposition to vertical fracture of the root (1,9). In vitro studies by Barkhorder, et al. (10) and Hemming, et al. (11) reported an improved resistance to fracture when encircling collars, or ferrules, were used with posts. Their results indicated that the design of the post did not influence resistance to fracture if the core was covered with a complete cast crown that extended 2 mm apical to the finish line of the core (1).

Posterior teeth

In posterior teeth, the consensus is that posts do not improve success; coronal coverage improves success (12). For molars, if the pulp chamber walls are intact and provide 3-4mm of vertical form, an amalgam well condensed into the chamber and 2 mm into each canal should form an adequate core (2). With more extensive loss of tooth structure, prefabricated posts placed in more than one root effectively resist rotational forces, and provide stabilization of the amalgam core (5,13). In either case, all undercuts are retained to provide additional retention for the core build up. Custom, cast post and cores for molars may require extensive modification to remaining tooth structure to obtain path of insertion.

Direct core materials

Direct placement core materials are usually silver amalgam, composite resin, or glass ionomer-based materials. Properties that are important predictors of the clinical behavior of a core material include compressive, shear and tensile strengths, along with rigidity (1). Silver amalgam has been reported to perform best as a core material under simulated clinical conditions because of its high compressive strength and rigidity (1,2). On the other hand, a number of studies have indicated that materials derived from glass ionomer cement perform poorly as a load-bearing core material (1,14). It appears that composite resin is an acceptable direct core material when substantial coronal tooth structure remains, but is less desirable when there is limited supporting dentin (1,14).

Cementation of posts

There are several luting agents available to the clinician. They include zinc phosphate, polycarboxylate, glass ionomer, resin modified glass ionomer, and resin cements. Filling the canal with cement will avoid air entrapment and ensure a uniform cement lute. A lentulo spiral is helpful to ensure cement is introduced to the apical extent of the post space; however, few cements provide adequate working time for its use. Zinc phosphate cement is often the cement of choice as it has an extended working time and high strength (1). The use of resin based cements for post and cores should be restricted to situations where minimal retention is available. Resin cements have demonstrated a tendency for increased dimensional change with water absorption that may predispose the root to fracture (1).

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